MP123E

M-406 Stage

User Manual

Version: 1.3.0 Date: 21.07.2014

This document describes the following micropositioning stages:

- M-406.xDG:
  With DC motor, rotary encoder
- M-406.xPD:
  With ActiveDrive DC motor, PWM, rotary encoder
- M-406.x2S:
  With 2-phase stepper motor

x stands for travel range:
2 = 50 mm
4 = 100 mm
6 = 150 mm

Physik Instrumente (PI) GmbH & Co. KG, Auf der Roemerstr. 1, 76228 Karlsruhe, Germany
Phone: +49 721 4846-0, Fax: +49 721 4846-1019, E-mail: info@pi.ws

Physik Instrumente (PI) GmbH & Co. KG is the owner of the following trademarks:
PI®, PIC®, PICMA®, PILine®, PIFOC®, PiezoWalk®, NEXACT®, NEXLINE®, NanoCube®, NanoAutomation®, Picoactuator®, PInano®

© 2014 Physik Instrumente (PI) GmbH & Co. KG, Karlsruhe, Germany. The text, photographs and drawings in this manual are protected by copyright. With regard thereto, Physik Instrumente (PI) GmbH & Co. KG retains all the rights. Use of said text, photographs and drawings is permitted only in part and only upon citation of the source.

Original instructions
First printing: 21.07.2014
Document number: MP123E, LMo, version 1.3.0

Subject to change without notice. This manual is superseded by any new release. The latest release is available for download (p. 3) on our website.

Contents

1 About this Document 1

1.1 Goal and Target Audience of this User Manual 1
1.2 Symbols and Typographic Conventions 1
1.3 Definition 2
1.4 Figures 3
1.5 Other Applicable Documents 3
1.6 Downloading Manuals 3

2 Safety 5

2.1 Intended Use 5
2.2 General Safety Instructions 5
2.3 Organizational Measures 6

3 Product Description 7

3.1 Model Overview 7
3.2 Product View 9
3.3 Product Labeling 10
3.4 Scope of Delivery 11
3.5 Accessories 11
3.6 Suitable Controllers 12
3.7 Technical Features 12
3.7.1 Encoder 12
3.7.2 Limit Switches 12
3.7.3 Reference Point Switch 13
3.7.4 Integrated PWM Amplifier 13

4 Unpacking 15

5 Installation 17

5.1 General Notes on Installation 17
5.2 Optional: Modifying the Connection Orientation on the M-406 18
5.2.1 M-406.xDG and M-406.xPD Models 19
5.2.2 M-406.x2S Models 20
5.3 Mounting the M-406 on a Surface 21
5.4 Affixing the Load to the M-406 24
5.5 Setting Up a Multi-Axis System 27
5.5.1 General Information on Setting Up a Multi-Axis System 27
5.5.2 Setting Up an XY System 28

5.5.3 Setting Up a Z System with an Adapter Bracket 31
5.6 Connecting the Motor Cable to the M-406 38
5.7 Connecting the Power Supply to the M-406 39

6 Start-Up 41

6.1 General Notes on Start-Up 41
6.2 Starting up the Stage 43
6.2.1 M-406 Entries in the Stage Database of PI 44
6.2.2 Operating Parameters of the Models with DC Motor 44
6.2.3 Operating Parameters of the Models with Stepper Motor 45

7 Maintenance 47

7.1 General Notes on Maintenance 47
7.2 Performing a Maintenance Run 47
7.3 Cleaning the M-406 48

8 Troubleshooting 49

8.1 Possible Causes and Correction 49
8.2 Manually Moving the Moving Platform 51
8.2.1 M-406.xDG and M-406.xPD Models 51
8.2.2 M-406.x2S Models 52

9 Customer Service 55

10 Technical Data 57

10.1 Specifications 57
10.1.1 Data Table 57
10.1.2 Maximum Ratings 58
10.1.3 Ambient Conditions and Classifications 59
10.1.4 Limit Switch Specifications 59
10.1.5 Reference Point Switch Specifications 60
10.2 Dimensions 61
10.2.1 M-406 Stage 61
10.2.2 Hole Pattern of the Moving Platform of the M-406 62
10.2.3 M-592.00 Adapter Bracket 63
10.3 Pin Assignment 64
10.3.1 Sub-D 15 (m) Controller Connection 64
10.3.2 Switchcraft 3-Pin Power Supply Connector 65

11 Old Equipment Disposal 67

12 EC Declaration of Conformity 69

1 About this Document

In this Chapter

Goal and Target Audience of this User Manual 1
Symbols and Typographic Conventions 1
Definition 2
Figures 3
Other Applicable Documents 3
Downloading Manuals 3

1.1 Goal and Target Audience of this User Manual

This manual contains information on the intended use of the M-406.

It assumes that the reader has a fundamental understanding of basic servo systems as well as motion control concepts and applicable safety procedures.

The latest versions of the user manuals are available for download (p. 3) on our website.

1.2 Symbols and Typographic Conventions

The following symbols and typographic conventions are used in this user manual:

CAUTION

Dangerous situation

If not avoided, the dangerous situation will result in minor injury.

➢ Actions to take to avoid the situation.

NOTICE

Dangerous situation

If not avoided, the dangerous situation will result in damage to the equipment.

➢ Actions to take to avoid the situation.

INFORMATION

Information for easier handling, tricks, tips, etc.

Symbol/ Label	Meaning
1. 2.	Action consisting of several steps whose sequential order must be observed
➢	Action consisting of one or several steps whose sequential order is irrelevant
▪	List item
p. 5	Cross-reference to page 5
RS-232	Labeling of an operating element on the product (example: socket of the RS-232 interface)
	Warning sign on the product which refers to detailed information in this manual.

1.3 Definition

Term	Explanation
Load capacity	Maximum load capacity in the vertical direction when the stage is mounted horizontally. The contact point of the load is in the center of the platform.
Max. push/pull force	Maximum force in the direction of motion. Some stages may have higher forces but with limited lifetimes. In the case of vertical mounting, the specified value (p. 57) for models without a gearhead and brake only applies when the servo mode is on.
Incremental position sensor	Sensor (encoder) for capturing changes of position or changes of angle. Signals from the incremental position sensor are used for axis position feedback. After switching on the controller a reference point definition must be performed before absolute target positions can be commanded and reached.

1.4 Figures

For better understandability, the colors, proportions and degree of detail in illustrations can deviate from the actual circumstances. Photographic illustrations may also differ and must not be seen as guaranteed properties.

1.5 Other Applicable Documents

The devices and software tools which are mentioned in this documentation are described in their own manuals.

Product	Document
C-863.11 DC Motor Controller	MS205E User Manual
C-663.11 Stepper Motor Controller	MS208E User Manual
C-843 DC Motor Controller PCI Board	MS77E User Manual
C-884 DC Motor Controller	MS213E User Manual
Stages with electric motors	MP119EK Short Instructions

1.6 Downloading Manuals

INFORMATION

If a manual is missing on our website or if there are problems in downloading:

➢ Contact our customer service department (p. 55).

The current versions of the manuals are found on our website. For some products (e.g. Hexapod systems and electronics that are delivered with a CD), access to the manuals is password-protected. The password is stored on the CD.

Download freely accessible manuals

1. Open the website **http://www.pi-portal.ws**.
2. Click ***Downloads***.
3. Click the corresponding category (e.g. ***M Products***)

4. Click the corresponding product code (e.g. ***M-406***).
5. Click ***Documents***.

   The available manuals are displayed.
6. Click the desired manual and save it on the hard disk of your PC or on a data storage medium.

Download password-protected manuals

1. Carry out steps 1 to 5 of the download process for freely accessible manuals.
2. Insert the product CD in the PC drive.
3. Switch to the ***Manuals*** directory on the CD.
4. In the ***Manuals*** directory, open the Release News (file including ***releasenews*** in the file name).
5. Find the user name and password in the ***User login for software download*** section in the Release News.
6. In the ***User login*** area on the left margin in the website, enter the user name and the password in the corresponding fields.
7. Click ***Login***.

   The available manuals are displayed.
8. Click the desired manual and save it on the hard disk of your PC or on a data storage medium.

2 Safety

In this Chapter

Intended Use 5
General Safety Instructions 5
Organizational Measures..... 6

2.1 Intended Use

The M-406 is a laboratory device as defined by DIN EN 61010. It is intended to be used in interior spaces and in an environment which is free of dirt, oil and lubricants.

In accordance with its design and realization, the M-406 is intended for single-axis positioning, adjusting and shifting of loads at different velocities. The M-406 is **not** intended for applications in areas in which a failure would present severe risks to human beings or the environment.

The M-406 is intended for horizontal or vertical mounting. For the load limits with vertical mounting, see "General Notes on Installation" (p. 17).

The intended use of the M-406 is only possible when completely mounted and connected.

The M-406 must be operated with a suitable controller (p. 12). The controller is not included in the scope of delivery of the M-406.

2.2 General Safety Instructions

The M-406 is built according to state-of-the-art technology and recognized safety standards. Improper use can result in personal injury and/or damage to the M-406.

- Only use the M-406 for its intended purpose, and only use it if it is in a good working order.
- Read the user manual.
- Immediately eliminate any faults and malfunctions that are likely to affect safety.

The operator is responsible for the correct installation and operation of the M-406.

2.3 Organizational Measures

User manual

- Always keep this user manual available by the M-406.
  The latest versions of the user manuals are available for download (p. 3) on our website.
- Add all information given by the manufacturer to the user manual, for example supplements or Technical Notes.
- If you pass the M-406 on to other users, also turn over this user manual as well as other relevant information provided by the manufacturer.
- Only use the device on the basis of the complete user manual. Missing information due to an incomplete user manual can result in minor injury and property damage.
- Only install and operate the M-406 after having read and understood this user manual.

Personnel qualification

The M-406 may only be installed, started up, operated, maintained and cleaned by authorized and appropriately qualified personnel.

3 Product Description

In this Chapter

Model Overview 7
Product View 9
Product Labeling 10
Scope of Delivery 11
Accessories 11
Suitable Controllers 12
Technical Features 12

3.1 Model Overview

Classification of the stages

The stages of the M-406.2xx, M-406.4xx and M-406.6xx series are summarized under the designation M-406 in this manual.

All models are micropositioning stages with precision leadscrew. They differ in terms of:

- Travel range
- Drive type

M-406	Travel range in mm	Travel range in inches
.2xx	50	2
.4xx	100	4
.6xx	150	6

Version	Drive type		
	DC motor		Stepper motor
	Gearhead, analog	Direct drive, PWM	
.xDG	●		
.xPD		●	
.x2S			●

Detailed model overview

Order Number	Product Name
M-406.2DG	Precision Translation Stage, 50 mm, DC Gear Motor
M-406.2PD	Precision Translation Stage, 50 mm, ActiveDrive DC Motor, includes 24 V Power Supply
M-406.22S	Precision Translation Stage, 50 mm, 2-Phase Stepper Motor
M-406.4DG	Precision Translation Stage, 100 mm, DC Gear Motor
M-406.4PD	Precision Translation Stage, 100 mm, ActiveDrive DC Motor, includes 24 V Power Supply
M-406.42S	Precision Translation Stage, 100 mm, 2-Phase Stepper Motor
M-406.6DG	Precision Translation Stage, 150 mm, DC Gear Motor
M-406.6PD	Precision Translation Stage, 150 mm, ActiveDrive DC Motor, includes 24 V Power Supply
M-406.62S	Precision Translation Stage, 150 mm, 2-Phase Stepper Motor

➢ For further technical data, see the specifications (p. 57).

3.2 Product View

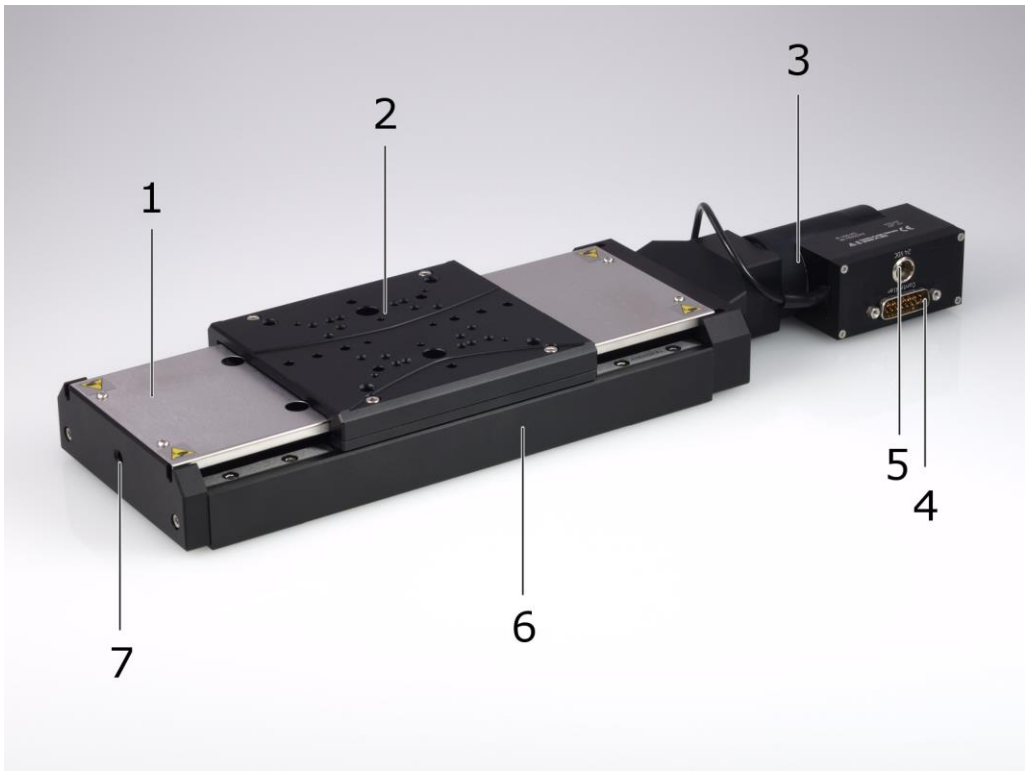


Figure 1: Components of the stage (in this case: M-406.4PD)

1 Protective cover
2 Moving platform
3 Motor
4 Controller connection (Sub-D 15 panel plug)
5 Power supply connector (Switchcraft panel plug, 3-pin, only with M-406.xPD models)
6 Base body
7 Drive screw access

3.3 Product Labeling

Figure 2: M-406: Position of the product labeling

Position	Labeling	Description
A		Warning sign "Risk of crushing": Reference to dangerous forces (p. 41)
B	PI	Manufacturer's logo
B	CE	CE conformity mark
B		Warning sign "Observe manual!"
B	M-406.4PD	Product name (example), the places after the point refer to the model
B	113050975	Serial number (example), individual for each M-406 Meaning of the places (counting from left): 1 = internal information, 2 and 3 = manufacturing year, 4 to 9 = consecutive numbers
B	WWW.PI.WS	Manufacturer's address (website)
B		Old equipment disposal (p. 67)
B	Country of origin: Germany	Country of origin

Position	Labeling	Description
C	Controller	Controller connection
C	24 VDC	Power supply connection (only with M-406.xPD models)

3.4 Scope of Delivery

Item ID	Component
M-406.xxx	Stage according to order (p. 7)
2110	Screw set for mounting the stage and load ▪ 6 M4x8-A2 hex-head cap screws ISO 4762 ▪ Allen wrench AF 3 DIN 911
C-815.38	Motor cable, 3 m, Sub-D 15 (m/f)
MP119EK	Short instructions for stages with electric motors
Only with M-406.xPD models	
C-663.PS	Wide-range-input power supply 24 V/42 W
3763	Power cord
K050B0002	Adapter for the power supply connection; barrel connector to Switchcraft 3-pin connector (f)

3.5 Accessories

Order Number	Description
C-815.83	Motor cable, 10 m, Sub-D, 15-pin (m/f)
M-592.00	Angle bracket for the vertical mounting of M-406 stages. Material: Al; mass: 0.2 kg
M-110.01	Adapter plate for mounting M-11x linear positioning stages on M-406 stages. Material: Al

To order, contact our customer service department (p. 55).

3.6 Suitable Controllers

The M-406 must be connected to a suitable controller. The following controllers from PI are suitable for the operation of the M-406:

Drive type	Controller	Axes per controller	PC interface	Multiple controllers on the same PC
DC motor	C-843	2 or 4	Internal (PCI bus)	Yes, separate boards
	C-863	1	USB, RS-232, daisy chain	Yes, same interface
	C-884	1 to 4	USB, RS-232, TCP/IP	Yes
Stepper motor	C-663	1	USB, RS-232, daisy chain	Yes, same interface

PC software is included in the scope of delivery of the controllers from PI. The operation of the controllers is described in the corresponding user manuals.

3.7 Technical Features

3.7.1 Encoder

The M-406.xPD and M-406.xDG models are equipped with an incremental rotary encoder.

A rotary encoder is implemented at a rotating point in the drivetrain, e.g. the motor shaft. To determine the relative position, the controller counts the encoder signals (impulses).

3.7.2 Limit Switches

The M-406 is equipped with non-contact, Hall-effect limit switches.

Each limit switch sends an overtravel signal on a dedicated line to the controller. The controller then stops the motion. If the controller does not stop the motion in time, the stage runs into the hard stop.

See "Limit Switch Specifications" (p. 59) for more information.

3.7.3 Reference Point Switch

The stage is equipped with a direction-sensing reference point switch that is located approximately in the middle of the travel range. This sensor transmits a TTL signal that indicates whether the stage is on the positive or negative side of the reference point switch.

The commands that use the reference signal are described in the user manual of the controller and/or in the corresponding software manuals.

3.7.4 Integrated PWM Amplifier

The M-406.xPD models with direct drive are equipped with a PWM amplifier ("ActiveDrive concept"). The motor and PWM amplifier are installed in a common case and thus optimally integrated and shielded. The PWM amplifier only receives the control signals from the controller, whereas the supply voltage is provided via an external power supply. The ActiveDrive concept allows a high motor power and dynamics with a low loss of power.

4 Unpacking

1. Unpack the M-406 with care.
2. Compare the contents against the items covered by the contract and against the packing list.
3. Inspect the contents for signs of damage. If parts are missing or you notice signs of damage, contact PI immediately.
4. Keep all packaging materials in case the product needs to be returned.

5 Installation

In this Chapter

General Notes on Installation 17
Optional: Modifying the Connection Orientation on the M-406 18
Mounting the M-406 on a Surface 21
Affixing the Load to the M-406 24
Setting Up a Multi-Axis System 27
Connecting the Motor Cable to the M-406 38
Connecting the Power Supply to the M-406 39

5.1 General Notes on Installation

NOTICE

Unintentional changes in position with vertical mounting!

If the load exceeds the self-locking of the drive when the stage is mounted vertically, unintentional changes in the position of the moving platform occur. Unintentional changes in position of the moving platform can damage the drive, the load or the environment.

➢ When a stage is mounted vertically, make sure that the installed load is lower than the self-locking of the drive (see "Data Table" (p. 57)).

NOTICE

Protruding screw heads!

Protruding screw heads can damage the M-406.

➢ Ensure that the screw heads do not protrude from counter-sunk holes so that they do not interfere with the stage motion.

NOTICE

Cable break!

A cable break leads to a failure of the stage.

- ➢ Install the stage so that the cable is not bent or crushed too severely during operation.
- ➢ If necessary: Modify the connection orientation of the stage (p. 18).

NOTICE

Heating up of the M-406 during operation!

The heat produced during operation of the M-406 can affect your application.

- ➢ Install the M-406 so that your application is not affected by the dissipating heat.

INFORMATION

For optimum repeatability, all components must be affixed without backlash.

- ➢ Make sure that the stage, load and - if present - the mounting adapter are affixed without backlash.

- ➢ If possible, perform a simulation of the stage motions with a mounted load or suitable calculations in order to identify collisions or unfavorable center of gravity constellations.
- ➢ If necessary, take suitable constructive measures to avoid collisions and instabilities in the overall system.
- ➢ Avoid or mark danger zones that result from the installation of the stage and the application, in accordance with the legal regulations.

5.2 Optional: Modifying the Connection Orientation on the M-406

INFORMATION

Motor and connections of the M-406 can be rotated around the axis of the motor and fixed in any position.

- ➢ Check whether the connections of the M-406 are in a position that is suitable for your installation situation.

5.2.1 M-406.xDG and M-406.xPD Models

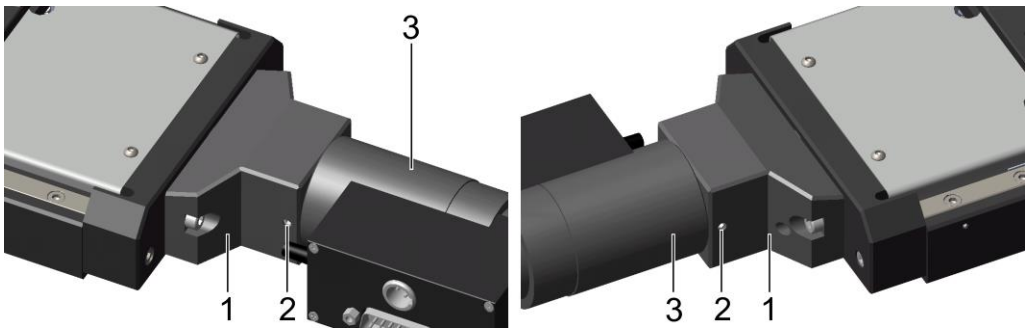


Figure 3: Position of the grub screws on the motor flange of the M-406.xDG and M-406.xPD models; left: Front view; right: Rear view

1 Motor flange
2 Grub screw
3 Motor case

Prerequisites

- ✓ The stage is **not** mounted on a surface.
- ✓ The stage is **not** connected to the controller and the power supply.

Tools and accessories

- Allen wrench AF 2

Modifying the connection orientation on the M-406.xDG and M-406.xPD models

1. Loosen the two grub screws on the motor flange.
2. Rotate the motor case with the connections into the desired orientation.
3. Make sure that the cables are not bent or crushed too severely in the selected orientation.
4. Tighten the two grub screws on the motor flange.

5.2.2 M-406.x2S Models

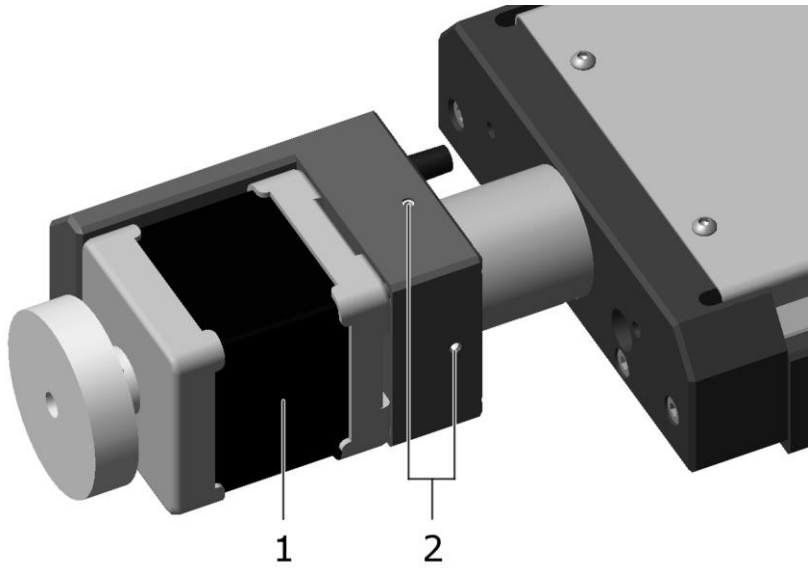


Figure 4: Position of the grub screw on the motor case of the M-406.x2S models

1 Motor case
2 Grub screws

Prerequisites

- ✓ The stage is **not** mounted on a surface.
- ✓ The stage is **not** connected to the controller.

Tools and accessories

- Allen wrench AF 1.5

Modifying the connection orientation on the M-406.x2S models

1. Loosen the two grub screws on the motor case.
2. Rotate the motor case with the connections into the desired orientation.
3. Make sure that the cables are not bent or crushed too severely in the selected orientation.
4. Tighten the two grub screws on the motor case.

5.3 Mounting the M-406 on a Surface

NOTICE

Warping of the M-406 due to mounting on uneven surfaces!

Mounting the M-406 on an uneven surface can warp the M-406. Warping reduces the accuracy.

- ➢ Mount the M-406 on an even surface. The recommended evenness of the surface is ≤10 µm.
- ➢ For applications with great temperature changes:
  Only mount the M-406 on surfaces that have the same or similar thermal expansion properties as the M-406.

NOTICE

Screws that are too long!

Mounting from below: Screws that are inserted too deeply can damage the M-406.

- ➢ Observe the depth of the mounting holes in the base body of the M-406 (p. 61).
- ➢ Only use screws of the correct length for the respective mounting holes.

NOTICE

Wear from manually moving the moving platform!

Manually moving the moving platform increases wear in the case of stages with a gearhead.

- ➢ With the M-406.xDG models, only move the platform manually if there is no other possibility for motion.

INFORMATION

The positive direction of motion is away from the cable exit side.

INFORMATION

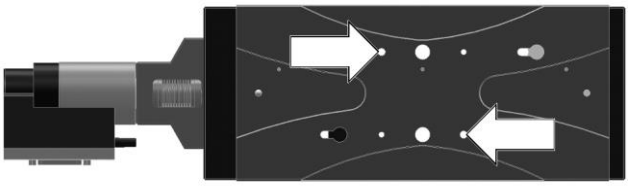
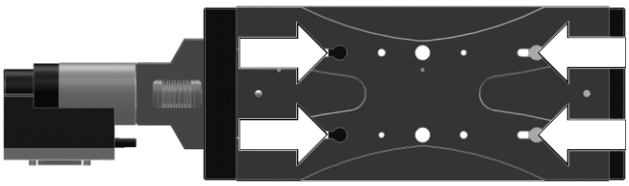
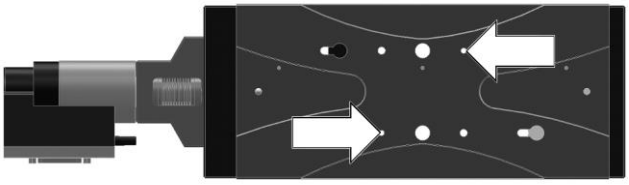
The required mounting holes may be covered by the moving platform, depending on which mounting option is selected.

Mounting option 1: The moving platform must be moved 25 mm away from the reference position (in positive or negative direction) in order to be able to reach the mounting holes through the auxiliary holes in the moving platform.

Mounting option 2: The moving platform must be in the reference position (delivery state).

➢ Move the moving platform if necessary.

The mounting holes of the M-406 are intended for the following mounting options:

Mounting option	Mounting method	Mounting holes, view from below, for details see "Dimensions" (p. 61)
1	Mounting from above with two M4x8 screws This mounting option is used e.g. when setting up an XY system consisting of two M-406 stages (p. 28).	 *Figure 5: Mounting the M-406 with two M4x8 screws from above*
2	Mounting from above with four M4x8 screws This mounting option is used e.g. when setting up an XZ/XYZ system consisting of two or three M-406 stages (p. 31).	 *Figure 6: Mounting the M-406 with four M4x8 screws*
3	Mounting from below with two M4 screws	 *Figure 7: Mounting the M-406 with two M4 screws from below*

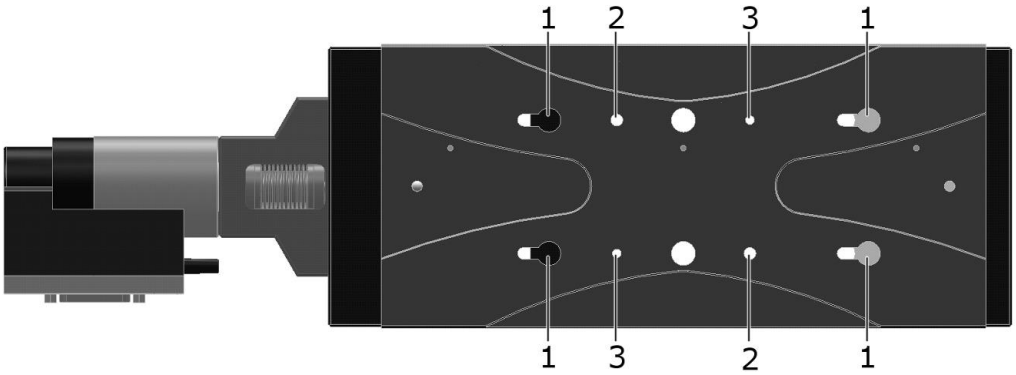


Figure 8: Mounting holes in the base body of the M-406, view from below

1 Mounting hole with slot for M4 hex-head cap screw
2 Mounting hole with counterbore for M4 hex-head cap screw
3 Mounting hole with M4 thread

Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have provided a suitable surface (for the required position and depth of the holes for accommodating the screws, see "Dimensions" (p. 61)):
  - For mounting from above: Two or four M4 threaded holes are provided.
  - For mounting from below: Two Ø 4.5 mm holes are provided.
  - The evenness of the surface is ≤ 10 µm.
  - For applications with great temperature changes: The surface should have the same or similar thermal expansion properties as the M-406 (e.g. surface made of aluminum).
- ✓ You accounted for the space required for cable routing free of kinks and in accordance with regulations.
- ✓ If you want to make the mounting holes in the base body of the M-406 accessible by moving the moving platform manually: The stage is **not** connected to the power supply and the controller.

Tools and accessories

- Mounting accessories:
  - For mounting from above: 2 or 4 M4x8 screws, included in the scope of delivery (p. 11)
  - For mounting from below: 2 M4 screws of suitable length (for the depth of the threaded holes in the base body of the M-406, see "Dimensions" (p. 61))
  - Allen wrench AF 3

Mounting the stage on a surface

1. If necessary: Make the mounting holes in the base body of the stage accessible. Possible measures:
   - Temporary start-up of the stage (p. 41) and commanding the platform to a suitable position
   - Manually moving the moving platform (p. 51)
2. Align the stage on the surface so that the corresponding mounting holes in the stage and surface overlap.
3. Completely screw in the screws into all mounting holes.
4. Check that the stage fits on the surface without backlash.

5.4 Affixing the Load to the M-406

NOTICE

Impermissibly high load on the stage!

An impermissibly high load interferes with the motion of the moving platform and can damage the stage.

➢ In respect to the mass and mounting type of the load, observe the maximum permissible forces that are allowed to act on the moving platform according to the specification (p. 57).

NOTICE

Screws that are too long!

Screws that are inserted too deeply can damage the M-406.

- ➢ Observe the depth of the mounting holes in the moving platform.
- ➢ Only use screws of the correct length for the respective mounting holes.

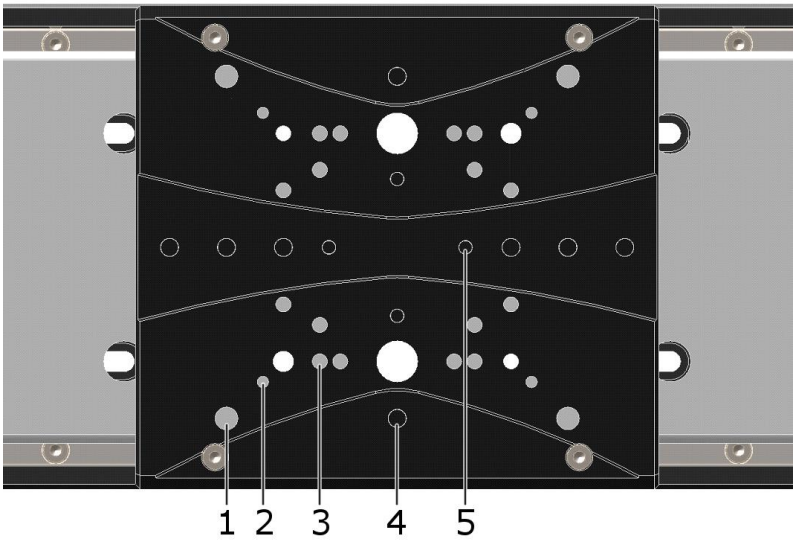


Figure 9: Holes in the moving platform of the M-406

1 M6 mounting hole, depth 4.8 mm (total of 4)
2 M3 mounting hole, depth 4.8 mm (total of 4)
3 M4 mounting hole, depth 4.8 mm (total of 18)
4 Locating hole Ø 4 mm H7, depth 4.1 mm (total of 8)
5 Locating hole Ø 3 mm H7, depth 4.1 mm (total of 4)

Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have properly mounted the stage on a surface (p. 21).
- ✓ The stage is **not** connected to the power supply and the controller.

✓ You have prepared the load so that it can be affixed to the mounting holes on the moving platform:

- The distance between the center of gravity of the load and the center of the moving platform is as small as possible in all directions.
- At least two points are provided for affixing the load to the moving platform (ideally: three or four attachment points).
- If you use locating pins to align the load: You have made two to four locating holes in the load with Ø 3 mm or 4 mm and a suitable tolerance for accommodating locating pins.

Tools and accessories

- At least 2 screws of suitable length. Options:
  - M3 screws
  - M4 screws
  - M6 screws
- Suitable tools for fastening the screws
- Optional: 2 to 4 locating pins for easy alignment of the load on the M-406, suitable for holes with Ø 3 mm or 4 mm; for tolerance data, see figure of the holes in the moving platform; locating pins not included in the scope of delivery

Affixing the load

1. Align the load so that the selected mounting holes in the moving platform can be used for affixing it.

   If you use locating pins to align the load:

   a) Insert the locating pins into the locating holes in the moving platform or the load.
   b) Place the load on the moving platform in such a way that the locating pins are inserted into the corresponding locating holes on the other side.

2. Affix the load to the selected mounting holes in the moving platform using the screws.
3. Check that the load fits on the moving platform of the stage without backlash.

5.5 Setting Up a Multi-Axis System

The M-406 can be used in multi-axis systems.

Typical combinations:

- XY system
- Z system (XZ or XYZ combination) with adapter bracket

➢ For combination possibilities with other stages, contact our customer service department (p. 55).

5.5.1 General Information on Setting Up a Multi-Axis System

NOTICE

Impermissibly high load on the stages!

In a multi-axis system, also the stage used for the Y and/or Z axis must be moved. Impermissibly high loads interfere with the motion and can damage the stages.

➢ Include the masses of the moved stages and the mounting adapters (p. 11) in the calculation of the load to be moved.

➢ For all stages in a multi-axis system: Do **not** exceed the maximum permissible load.

➢ When a stage is installed vertically, make sure that the installed load is lower than the self-locking of the drive.

NOTICE

Wear from manually moving the moving platform!

Manually moving the moving platform increases wear in the case of stages with a gearhead.

➢ With the M-406.xDG models, only move the platform manually if there is no other possibility for motion.

➢ Only install and operate the multi-axis system after you have read and understood the user manuals of all components of the multi-axis system.

➢ If you require special mounting adapters, contact our customer service department (p. 55).

5.5.2 Setting Up an XY System

NOTICE

Screws that are too long!

The lower stage can be damaged by screws that are inserted too deeply.

- ➢ Observe the depth of the mounting holes in the moving platform of the lower stage.
- ➢ Only use screws of the correct length for the respective mounting holes.

Designations in these instructions:

- **Lower stage**: Forms the basis of the multi-axis system (X-axis), is attached to a surface
- **Upper stage**: Forms the Y-axis of the multi-axis system, is attached to the lower stage rotated by 90°

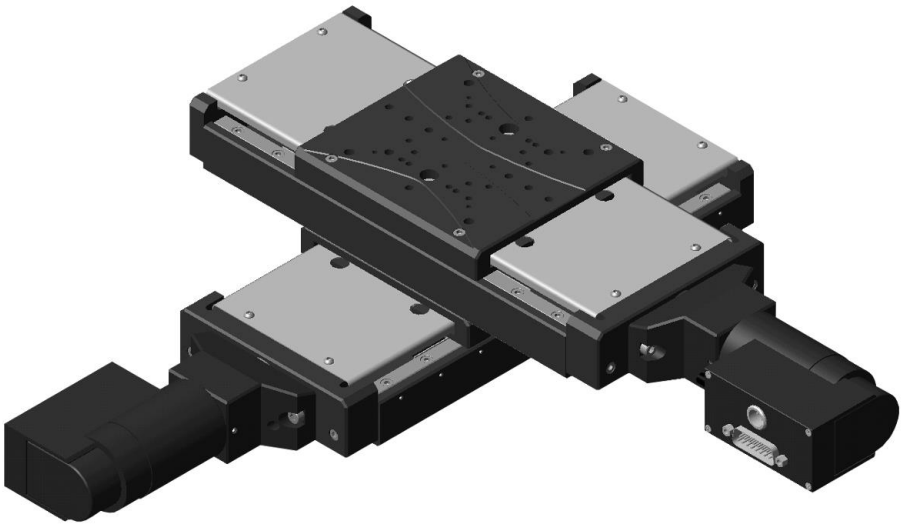


Figure 10: Example: XY system consisting of two M-406 stages

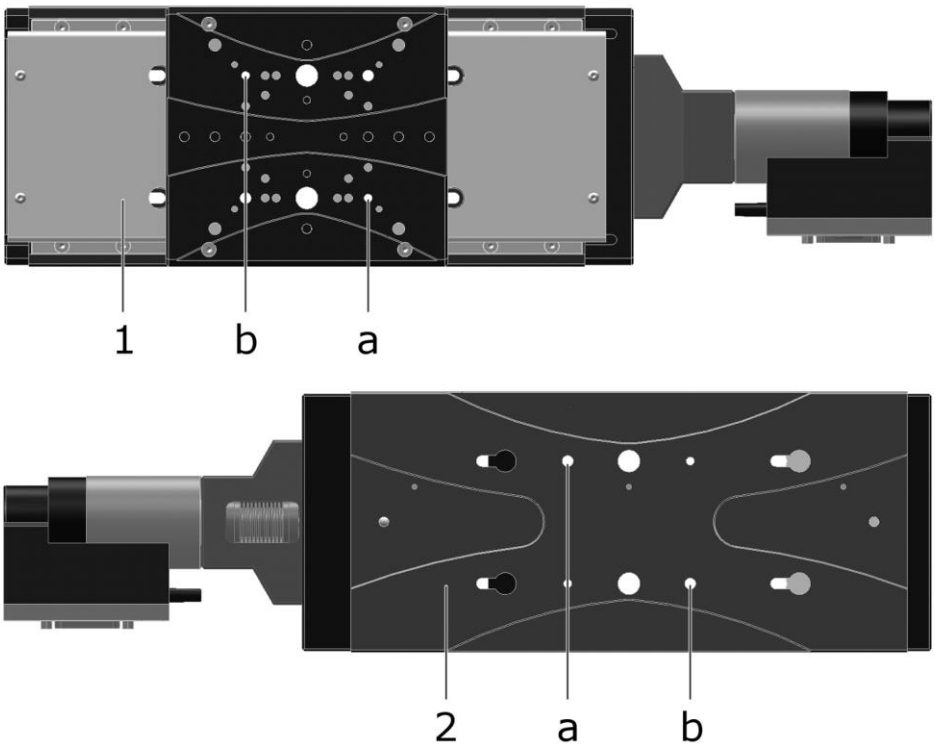


Figure 11: Setting up an XY system from two M-406

1 Lower stage with
a, b) M4 mounting holes in the platform

2 Upper stage (view from below) with
a, b) mounting holes with counterbore for M4 hex-head cap screws, in the base body of the stage

Holes that overlap during attachment are marked with the same letter.

Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have read and understood the general notes on setting up a multi-axis system (p. 27).
- ✓ You accounted for the space required for cable routing free of kinks and in accordance with regulations.

✓ The used stages are disconnected from the power supply and controller.

✓ You have properly attached the lower stage to a surface (p. 21).

Tools and accessories

- 2 M4 screws of suitable length from the scope of delivery of the upper stage
  - When an M-406 is mounted to an M-406 as in the figure above: 2 M4x8 screws
- Allen wrench AF 3, in the scope of delivery of the stages

Setting up an XY system

1. If necessary: Make the first of the two mounting holes in the base body of the upper stage accessible. Possible measures:
   - Temporary start-up of the upper stage (p. 41) and commanding the platform to a suitable position
   - Manually moving the moving platform of the upper stage (p. 51)
2. Position the upper stage rotated by 90° on the moving platform of the lower stage (see above figure).
3. Align the upper stage so that the corresponding mounting holes in the upper and lower stage overlap (holes a and b in the figure above).
4. Completely screw in one M4 screw into the hole a.
5. Make the second of the two mounting holes in the base body of the upper stage accessible. Possible measures:
   - Temporary start-up of the upper stage (p. 41) and commanding the platform to a suitable position
   - Manually moving the moving platform of the upper stage (p. 51)
6. Completely screw in one M4 screw into the hole b.
7. Check that the upper stage fits without backlash.

5.5.3 Setting Up a Z System with an Adapter Bracket

NOTICE

Screws that are too long!

The lower stage can be damaged by screws that are inserted too deeply.

- ➢ Observe the depth of the mounting holes in the moving platform of the lower stage.
- ➢ Only use screws of the correct length for the respective mounting holes.

Designations in these instructions:

- **Lower stage**: X axis in an XZ combination; Y axis in an XYZ combination. The stage to which the upper stage is attached with an adapter bracket.
- **Upper stage**: Forms the Z axis of the multi-axis system, is mounted in a vertical alignment to the lower stage with an adapter bracket.

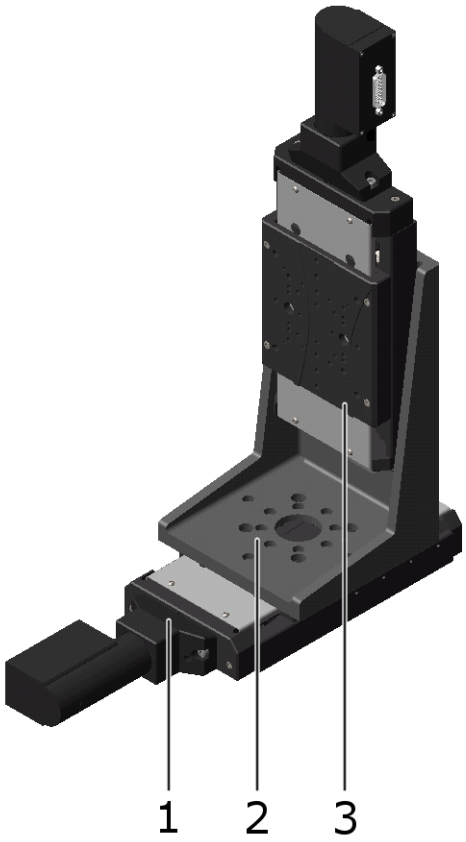


Figure 12: Example: XZ combination consisting of two M-406.2DG stages

1 Lower stage
2 M-592.00 adapter bracket
3 Upper stage

Prerequisites

- ✓ You have read and understood the general notes on installation (p. 17).
- ✓ You have read and understood the general notes on setting up a multi-axis system (p. 27).
- ✓ You accounted for the space required for cable routing free of kinks and in accordance with regulations.

- ✓ The used stages are disconnected from the power supply and controller.
- ✓ If you set up an XZ combination: You have properly attached the lower stage to a surface (p. 21).
- ✓ If you set up an XYZ combination: You have properly attached the stages for the X and Y axis (p. 28).

Tools and accessories

- Suitable adapter bracket, available as an optional accessory (p. 11):
  - M-592.00 when an M-406 stage is used as Z axis
- For attaching the Z axis to the adapter bracket: Four M4 screws of suitable length from the scope of delivery of the upper stage
  - When an M-406 is used as Z axis as in the figure above: 4 M4x8 screws
- For attaching the adapter bracket to the lower stage: M4 screws of suitable length
  - When the M-592.00 adapter bracket is attached to an M-406: 4 M4x8 screws
- Allen wrench AF 3, in the scope of delivery of the stage

Setting up a Z system

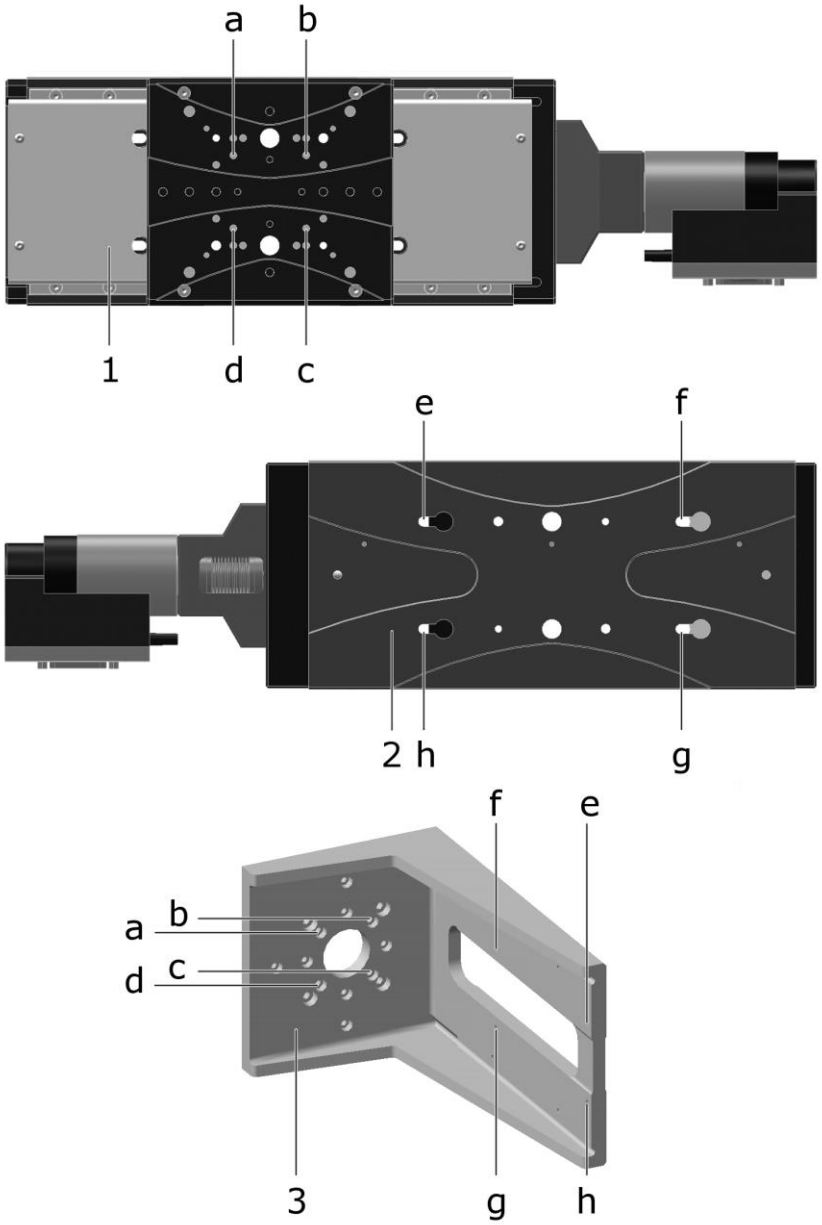


Figure 13: Example: Setting up an XZ combination from two M-406 stages and M-592.00 adapter bracket

1 Lower stage

2 Upper stage (view from below)

3 M-592.00 adapter bracket

a-h: mounting holes:

Holes that overlap during attachment are marked with the same letter

1. Attach the adapter bracket to the lower stage:

Figure 14: Attaching the adapter bracket to the lower M-406

   a) Align the M-592.00 adapter bracket on the moving platform of the lower stage so that mounting holes a to d in the adapter bracket and the moving platform overlap.
   b) Completely screw in one screw into each mounting hole a to d.

2. Check that the adapter bracket fits without backlash.

3. Screw one screw into each of the mounting holes e to h of the adapter bracket to a depth of approx. 2 mm.

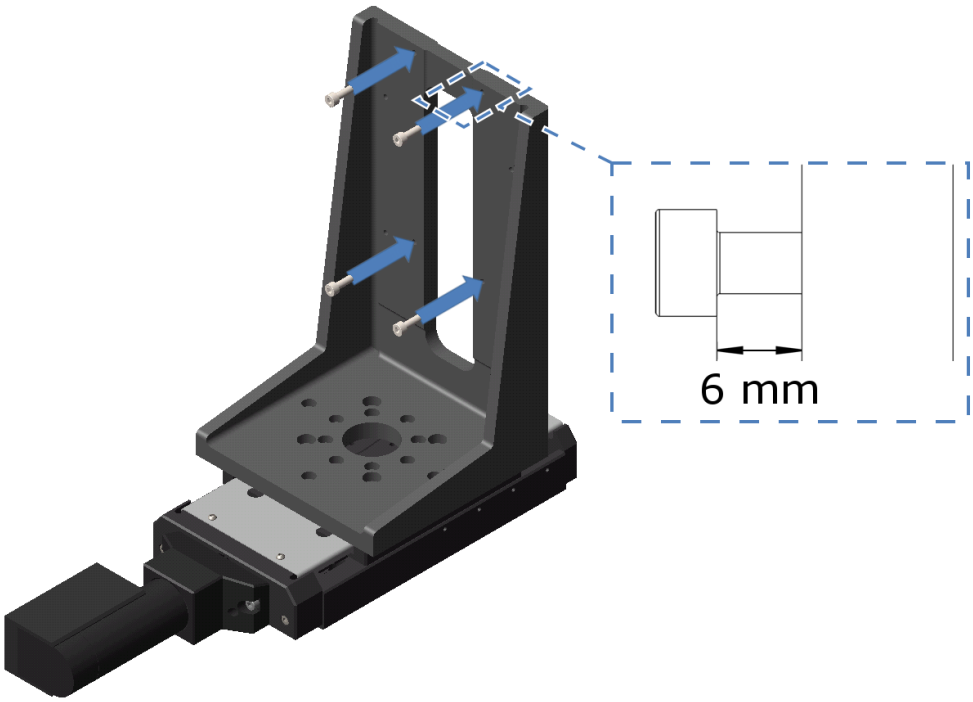


Figure 15: Screw in screws for the upper M-406 in the adapter bracket

4. Attach the upper stage to the adapter bracket:

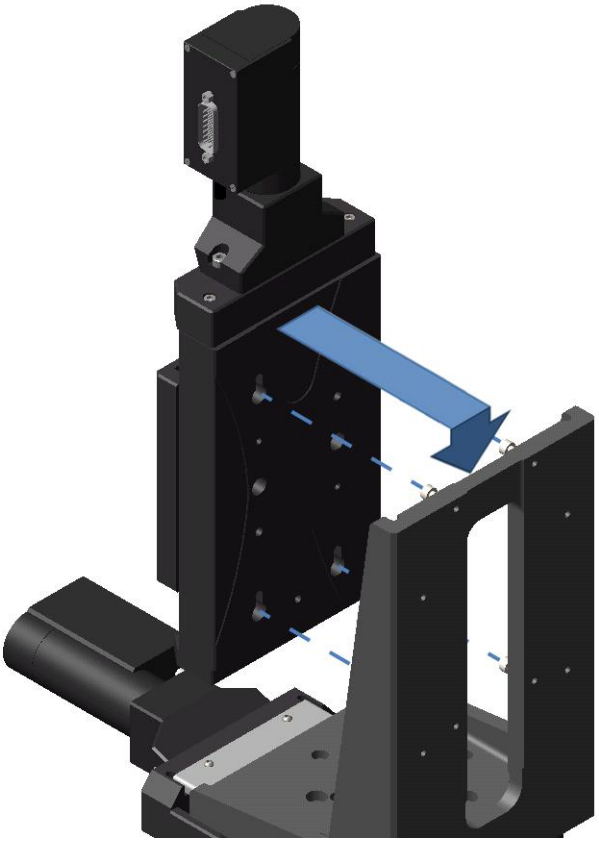


Figure 16: Attaching the upper M-406 to the adapter bracket

a) If necessary: Make two of the four required mounting holes in the base body of the stage accessible. Possible measures:
   - Temporary start-up of the upper stage (p. 41) and commanding the platform to a suitable position
   - Manually moving the moving platform (p. 51)

b) Position the stage on the long surface of the adapter bracket as in the figure:
   - The stage lies on the inside of the bracket.
   - The motor of the stage faces the open end of the inside of the bracket (i.e. upwards in the Z system).
   - Mounting holes e to h in the stage overlap with the screws in the corresponding holes.

c) Hook the stage on the screws, located in holes e to h.

d) Slide the stage along the slots of holes e to h in the direction of the lower stage until you feel resistance (approx. 10 mm).
e) Tighten the two screws that have become accessible.
f) Make the remaining two mounting holes in the base body of the stage accessible. Possible measures:
   – Temporary start-up of the upper stage (p. 41) and commanding the platform to a suitable position
   – Manually moving the moving platform (p. 51)
g) Tighten the two screws that have become accessible.

5. Check that the stage fits without backlash.

5.6 Connecting the Motor Cable to the M-406

Prerequisites

✓ You have read and understood the general notes on installation (p. 17).
✓ The motor cable is not connected to the controller.

Tools and accessories

- Suitable motor cable from PI, e.g.:
  – Motor cable C-815.38, 3 m, Sub-D, 15-pin (m/f), in the scope of delivery (p. 11).
  – Motor cable C-815.83, 10 m, Sub-D, 15-pin (m/f), available as optional accessory (p. 11).

Connecting the motor cable to the M-406

1. Connect the connector (f) of the motor cable to the Sub-D 15-pin panel plug (m) of the stage.
2. Secure the connector (f) with the two integrated screws against being unintentionally pulled out of the stage.

5.7 Connecting the Power Supply to the M-406

Connecting a power supply is only necessary with the M-406.2PD, .4PD and .6PD models.

Prerequisites

✓ The power cord is **not** connected to the power socket.

Tools and accessories

- Included 24 V wide-range-input power supply (for line voltages between 100 and 240 VAC at 50 or 60 Hz)
- Alternatively: Sufficiently dimensioned power supply that provides 24 VDC with a maximum of 2.0 ampere
- Included adapter for the power supply connector; barrel connector to Switchcraft 3-pin connector (f)
- Alternatively: Sufficiently dimensioned adapter
- Included power cord
- Alternatively: Sufficiently dimensioned power cord

Connecting the power supply to the M-406

➢ Connect the Switchcraft connector (f) of the adapter to the Switchcraft panel plug of the M-406.

➢ Connect the barrel connector of the adapter to the barrel connector socket of the power supply.

➢ Connect the power cord to the power supply.

6 Start-Up

In this Chapter

General Notes on Start-Up 41
Starting up the Stage 43

6.1 General Notes on Start-Up

CAUTION

Risk of crushing by moving parts!

There is a risk of minor injury from crushing between the movable parts of the stage or the load and a fixed part or obstacle.

- ➢ Use protective structures to keep limbs away from areas in which they could be seized by moving parts.
- ➢ Observe the safety distances in accordance with DIN EN ISO 13857 when installing protective structures.

NOTICE

Damage from collisions!

Collisions can damage the stage, the load to be moved and the environment.

- ➢ Make sure that no collisions are possible between the stage, the load to be moved and the environment in the motion range of the stage.
- ➢ Do not place any objects in areas where they can get caught by moving parts.
- ➢ Stop the motion immediately if a controller malfunction occurs.
- ➢ If possible, adapt the travel range limits of your mechanical system in the software that you use for commanding the motion.

NOTICE

Damage if an incorrect controller is connected!

Connecting a stage to an unsuitable controller can cause damage to the stage or controller.

- ➢ Connect a stage with DC motor to a DC motor controller only.
- ➢ Connect a stage with stepper motor to a stepper motor controller only.
- ➢ If you use controllers and software from other manufacturers, check their technical data to make sure that they are suitable before starting up the stage!

NOTICE

Operating voltage too high or incorrectly connected!

Operating voltages that are too high or incorrectly connected can cause damage to the M-406.

- ➢ Do **not** exceed the operating voltage range (p. 58) for which the M-406 is specified.
- ➢ Only operate the M-406 when the operating voltage is properly connected; see "Pin Assignment" (p. 64).

NOTICE

Damage or considerable wear from high accelerations!

High accelerations can cause damage to or considerable wear on the mechanical system.

- ➢ Stop the motion immediately if a controller malfunction occurs.
- ➢ Ensure that the end of the travel range is approached at low velocity.
- ➢ Determine the maximum velocity for your application.

NOTICE

Unintentional motions!

When the M-406 is being connected to the controller, it can carry out unintentional motions. Defective software or wrong operation of the software can also result in unintentional motions.

- ➢ Do not place any objects in areas where they can get caught by moving parts.
- ➢ Before connecting the M-406, check whether a macro is defined as the start-up macro in the controller, and cancel the selection of the start-up macro if necessary.

INFORMATION

The maximum velocity for a stage with a stepper motor should be determined in the application. If the commanded velocity is too high, the stepper motor might stop without the controller detecting this condition.

INFORMATION

The repeatability of the positioning is only ensured when the reference point switch is always approached from the same side. Controllers from PI fulfill this requirement as a result of the automatic direction sensing for reference moves to the reference switch.

INFORMATION

For models with DC motors:

Unsuitable settings made to the servo-control parameters can impair the performance of the M-406. The consequences of this can be expressed as follows:

- Oscillations
- Imprecise approach of the position
- Settling time is too long

➢ If the performance of the M-406 is not satisfactory, check the settings for the servo-control parameters of your controller.

6.2 Starting up the Stage

Prerequisites

✓ You have read and understood the General Notes on Start-Up (p. 41).

✓ For starting up with a load or in a multi-axis system: You have properly installed the stage (p. 27).

✓ You have read and understood the user manual of the used controller.

✓ You have read and understood the manual of the used PC software.

✓ The controller and the required PC software have been installed. All connections on the controller have been set up (see user manual of the controller; the stage is connected via the motor cable).

Starting up the stage

1. Only M-406.xPD models: Connect the power cord of the power supply with the power socket.
2. Start up the controller (see user manual of the controller).

   Configure the controller during the start-up using the PC software for the used stage (see user manual of the controller and of the PC software):

   – If you use a controller from PI: Select the entry in the stage database that precisely fits the used stage model (p. 44).

   – If you use a controller from another manufacturer: Enter the parameters that precisely fit the used stage model in the corresponding PC software; see the overview of the operating parameters for DC motor controllers (p. 44) or stepper motor controllers (p. 45).
3. Start a few motion cycles for testing purposes (see user manual of the controller).

6.2.1 M-406 Entries in the Stage Database of PI

For controllers from PI, you can select the connected stage from a stage database in the corresponding PC software. The appropriate operating parameters are thus loaded to the controller. You can find a detailed description in the user manual for the controller or in the manual for the PC software used.

6.2.2 Operating Parameters of the Models with DC Motor

If you use a DC motor controller from a third-party supplier, it may be necessary to enter operating parameters for adaptation to the used stage.

Parameter	M-406 model		Unit
	.xDG	.xPD	
P-Term	250	250	-
I-Term	40	300	-
D-Term	800	400	-
I-Limit	2000	2000	-
Maximum acceleration	30	300	mm/s²
Maximum velocity*	1	15	mm/s
Maximum velocity*	118568	12000	counts/s

Parameter	M-406 model		Unit
	.xDG	.xPD	
Gear reduction	29.6:1	-	-
Encoder resolution	118568	8000	counts/mm
Limit switch polarity	Active high	Active high	-

* Recommended for continuous operation

6.2.3 Operating Parameters of the Models with Stepper Motor

If you use a stepper motor controller from a third-party supplier, it may be necessary to enter operating parameters for adaptation to the used stage.

Parameter	M-406.x2S	Unit
Recommended start values:		
Holding current	200	mA
Operating current	600	mA
Holding current delay	500	ms
Max. motor current	850	mA
Max. acceleration	10	mm/s^2
Max. velocity*	2	mm/s
Max. velocity*	800	Full steps/s
Hardware properties:		
Limit switch polarity	Active low	-
Full steps	400	steps/revolution
Phase resistance	6.6	ohm
Max. phase current, bipolar	850	mA

* Recommended for continuous operation

7 Maintenance

In this Chapter

General Notes on Maintenance 47
Performing a Maintenance Run 47
Cleaning the M-406 48

7.1 General Notes on Maintenance

NOTICE

Damage due to improper maintenance!

Improper maintenance can lead to misalignment and failure of the M-406.

➢ Only loosen screws according to the instructions in this manual.

7.2 Performing a Maintenance Run

Depending on the operating conditions and the period of use of the M-406, the following maintenance measures are required:

Maintenance run

The maintenance run serves to distribute the lubricant that is present.

- ➢ After 500 operating hours or at least after 1 year, carry out a maintenance run over the entire travel range, in order for the lubricant present to be equally distributed.
- ➢ If you operate your stage continuously over only a small working range (<20% of the entire travel range), perform a run across the entire travel range approximately every 2000 motion cycles.

Lubrication

Under laboratory conditions, the stage needs extra lubrication in exceptional cases only. For continuous industrial use, the lubrication intervals must be defined individually.

- Do not lubricate the M-406 without consulting our customer service department (p. 55).
- To lubricate, follow the instructions given in the maintenance manual which you can obtain from our customer service department.

7.3 Cleaning the M-406

Prerequisites

- ✓ You have disconnected the stage from the controller.

Cleaning the stage

- When necessary, clean the stage surface with a cloth lightly dampened with a mild cleanser or disinfectant.
- Do **not** use any organic solvents.

8 Troubleshooting

In this Chapter

Possible Causes and Correction 49
Manually Moving the Moving Platform 51

8.1 Possible Causes and Correction

Problem	Possible Causes	Solution
Reduced positioning accuracy	Warped base body	➢ Mount the M-406 on an even surface. The recommended evenness of the surface is 10 µm.
	When the M-406 is mounted vertically: The load exceeds the self-locking of the drive.	➢ Do **not** exceed the maximum permissible stress and load capacities according to the specifications (p. 57).
	Increased wear due to small motions over a long period of time	➢ Carry out a maintenance run over the entire travel range (p. 47).
Functional impairment after system modification	▪ Controller has been replaced. ▪ M-406 has been replaced with another model.	Controller from PI: ➢ Load the parameters from the stage database that correspond to the combination of controller and M-406 model. Controller from a third-party supplier: ➢ Check the operating parameters.
Mechanical system does not move; no operating noise can be heard.	Controller and/or power supply are incorrectly connected or defective.	➢ Check all connection cables. ➢ Check the controller. ➢ If present: Check the power supply of the stage.
	When a PI controller is used: A motion error of the axis is present.	Motion error = The difference between the current position and the commanded position exceeds the specified maximum value in closed-loop operation. Motion errors can be

Problem	Possible Causes	Solution
		caused, for example, by malfunctions of the drive or the position sensor of the stage. 1. Read out the error code of the controller in the PC software. If a motion error is present, the error code -1024 is output. 2. Check your system and make sure that all axes can be moved safely. 3. Switch on the servo mode for the affected axis in the PC software. For details, see the user manual of the controller.
	Moving platform has triggered the limit switch p. 12.	If you use a controller from PI: 1. Switch on the servo mode for the affected axis again in the PC software. 2. Command an axis motion away from the limit switch in the PC software.
In the case of models with a stepper motor: The mechanical system does not move any more but produces an operating noise.	The motor is overloaded by an external load torque or by the mass to be driven with a strong acceleration or deceleration.	The motor skips steps. The information on the current position is lost without the controller recognizing this state. ➢ Determine the maximum velocity for a stage with a stepper motor in the application.

If the problem that occurred with your system is not listed in the table above or cannot be solved as described, contact our customer service department (p. 55).

8.2 Manually Moving the Moving Platform

INFORMATION

In the following cases, it can be necessary to manually move the moving platform:

- Make mounting holes for M4 screws accessible in the base body of the stage.
- Move the moving platform away from the hard stop in order to make the stage operational again.

8.2.1 M-406.xDG and M-406.xPD Models

NOTICE

Wear from manually moving the moving platform!

Manually moving the moving platform increases wear in the case of stages with a gearhead.

➢ With the M-406.xDG models, only move the platform manually if there is no other possibility for motion.

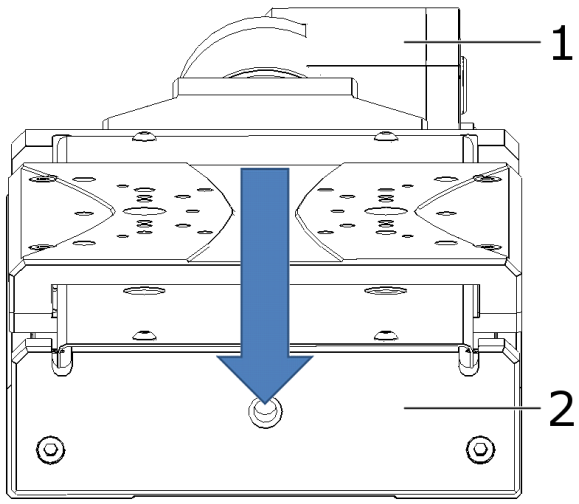


Figure 17: Position of the drive screw access on the M-406

1 Motor

2 Front face

Prerequisites

The stage is **not** connected to the power supply and the controller.

Tools and accessories

- Allen wrench AF 3 (in the scope of delivery)

Manually moving the moving platform

1. Introduce the Allen wrench into the drive screw access in the front face of the stage until you feel resistance.
2. Rotate the Allen wrench as far as necessary:
   - Clockwise rotation: Platform moves towards the motor
   - Counter-clockwise rotation: Platform moves away from the motor

The rotary motion is transferred directly to the drive screw.

8.2.2 M-406.x2S Models

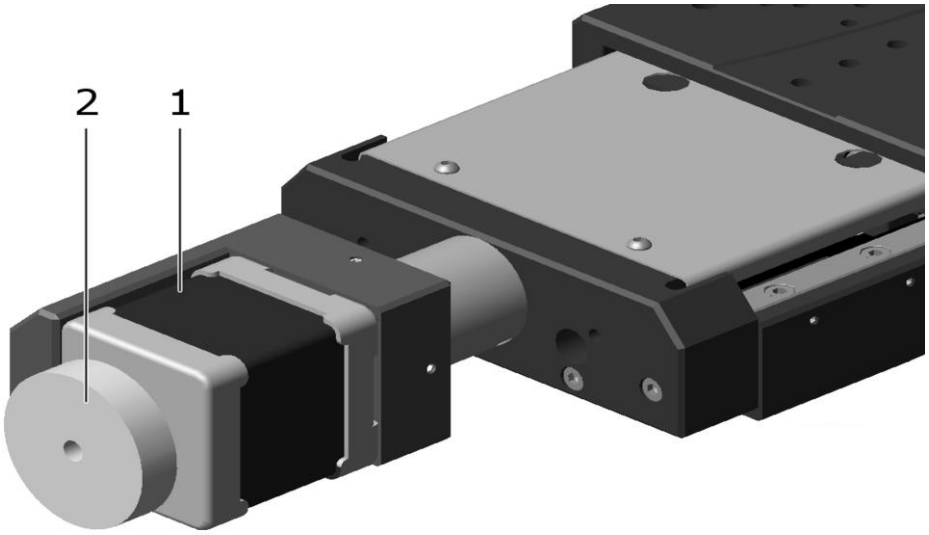


Figure 18: Position of the damper for the stepper motor on the M-406.x2S

1 Motor
2 Damper for stepper motor

Prerequisites

The stage is **not** connected to the controller.

Manually moving the moving platform

- Rotate the damper for the stepper motor as far as necessary:
  - Clockwise rotation: Platform moves away from the motor
  - Counter-clockwise rotation: Platform moves in the direction of the motor

The rotary motion is transferred directly to the drive screw.

9 Customer Service

For inquiries and orders, contact your PI sales engineer or send us an e-mail (mailto:info@pi.ws).

If you have questions concerning your system, have the following information ready:

- Product codes and serial numbers of all products in the system
- Firmware version of the controller (if present)
- Version of the driver or the software (if present)
- Operating system on the PC (if present)

The latest versions of the user manuals are available for download (p. 3) on our website.

10 Technical Data

In this Chapter

Specifications 57
Dimensions 61
Pin Assignment 64

10.1 Specifications

10.1.1 Data Table

Preliminary data	M-406.2DG / M-406.4DG / M-406.6DG	M-406.2PD / M-406.4PD / M-406.6PD	M-406.22S / M-406.42S / M-406.62S	Unit
Motion and positioning				
Travel range	50 / 100 / 150	50 / 100 / 150	50 / 100 / 150	mm
Integrated sensor	Rotary encoder	Rotary encoder	-	
Sensor resolution	2000	4000	-	cts./rev.
Design resolution	0.0085	0.125	0.0781	µm
Min. incremental motion	0.1	0.25	0.1	µm
Unidirectional repeatability	0.2	0.2	0.2	µm
Backlash	2	2	2	µm
Crosstalk, angular error	±25 / ±50 / ±75	±25 / ±50 / ±75	±25 / ±50 / ±75	µrad
Max. velocity	1	15	3.5	mm/s
Mechanical properties				
Thread pitch	0.5	0.5	0.5	mm
Gear ratio	29.6:1	-	-	
Max. load	200	200	200	N
Max. push / pull force	50 / 50	50 / 50	50 / 50	N
Max. lateral force	150	150	150	N

Preliminary data	M-406.2DG / M-406.4DG / M-406.6DG	M-406.2PD / M-406.4PD / M-406.6PD	M-406.22S / M-406.42S / M-406.62S	Unit
Drive properties				
Motor type	DC gear motor	DC motor with PWM control	2-phase stepper motor*	
Operating voltage	0 to ±12	24 (PWM)	24	V
Motor power	3	30	-	W
Motor resolution	-	-	6.400*	steps/rev.
Reference point and limit switches	Hall effect	Hall effect	Hall effect	
Miscellaneous				
Operating temperature range	-20 to 65	-20 to 65	-20 to 65	°C
Material	Aluminum, steel	Aluminum, steel	Aluminum, steel	
Mass	2.1 / 2.4 / 2.8	2.1 / 2.4 / 2.8	2.1 / 2.4 / 2.8	kg
Connector	Sub-D 15-pin, 3 m cable incl.	Sub-D 15-pin, 3 m cable incl.	Sub-D 15-pin, 3 m cable incl.	
Recommended controller / driver	C-863 (single-axis), C-884 (up to 4 axes)	C-863 (single-axis), C-884 (up to 4 axes)	C-663 (single-axis)	

* Max. 0.85 A/phase; 400 full steps/rev., motor resolution with C-663 stepper motor controller

Ask about custom designs!

10.1.2 Maximum Ratings

M-406 stages are designed for the following operating data:

Device	Maximum Operating Voltage	Operating Frequency	Maximum Power Consumption
M-406.xDG	12 V	0 Hz	3 W
M-406.xPD	24 V	0 Hz	30 W
M-406.x2S	24 V	0 Hz	U * 0.85 A/phase

10.1.3 Ambient Conditions and Classifications

The following ambient conditions and classifications must be observed for the M-406:

Area of application	For indoor use only
Maximum altitude	2000 m
Relative humidity	Highest relative humidity 80 % for temperatures up to 31 °C Decreasing linearly to 50 % relative humidity at 40 °C
Storage temperature	0 °C to 80 °C
Transport temperature	0 °C to 80 °C
Supply fluctuations	Not more than ±10 % of the nominal voltage
Degree of pollution	2
Degree of protection according to IEC 60529	IP40

10.1.4 Limit Switch Specifications

Type	Magnetic (Hall-effect) sensor
Supply voltage	+5 V/ground
Signal output	TTL level
Signal logic	The signal level changes when passing the limit switch. The signal logic depends on the model type: ▪ Models with DC motor: **active high**. That means: – Normal motor operation: low (0 V) – Limit switch reached: high (+5 V) ▪ Models with stepper motor: **active low**. That means: – Normal motor operation: high (+5 V) – Limit switch reached: low (0 V)

10.1.5 Reference Point Switch Specifications

Type	Magnetic (Hall-effect) sensor
Supply voltage	+5 V/GND
Signal output	TTL level
Signal logic	Direction sensing by means of different signal levels on the left and right side of the reference point switch: The signal level changes from 0 to +5 V when the reference point switch is passed.

10.2 Dimensions

10.2.1 M-406 Stage

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

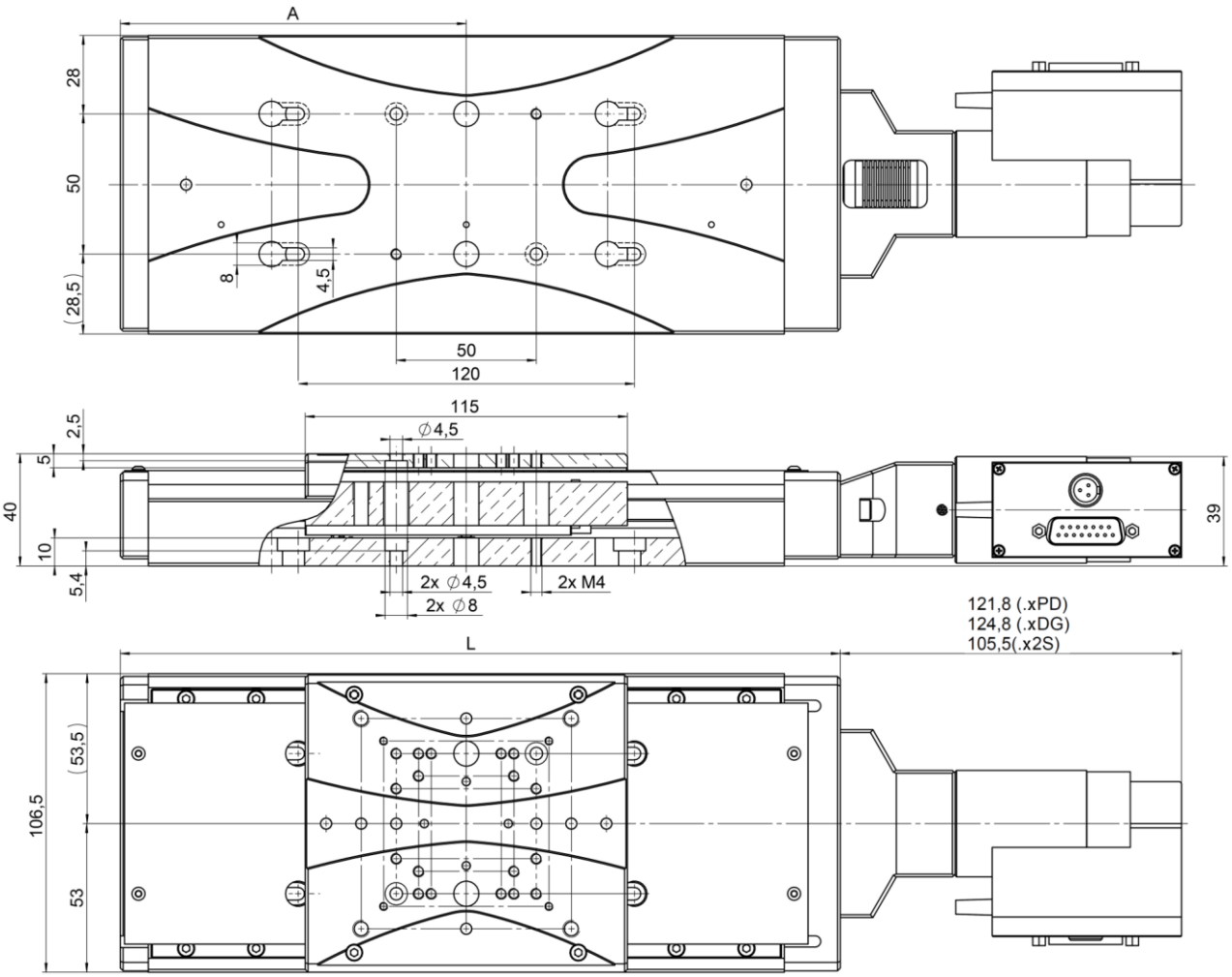


Figure 19: Dimensions for the M-406 series, see table for the values of the variables

Models	L	A
M-406.2xx	207	98.5
M-406.4xx	257	123.5
M-406.6xx	307	98

10.2.2 Hole Pattern of the Moving Platform of the M-406

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

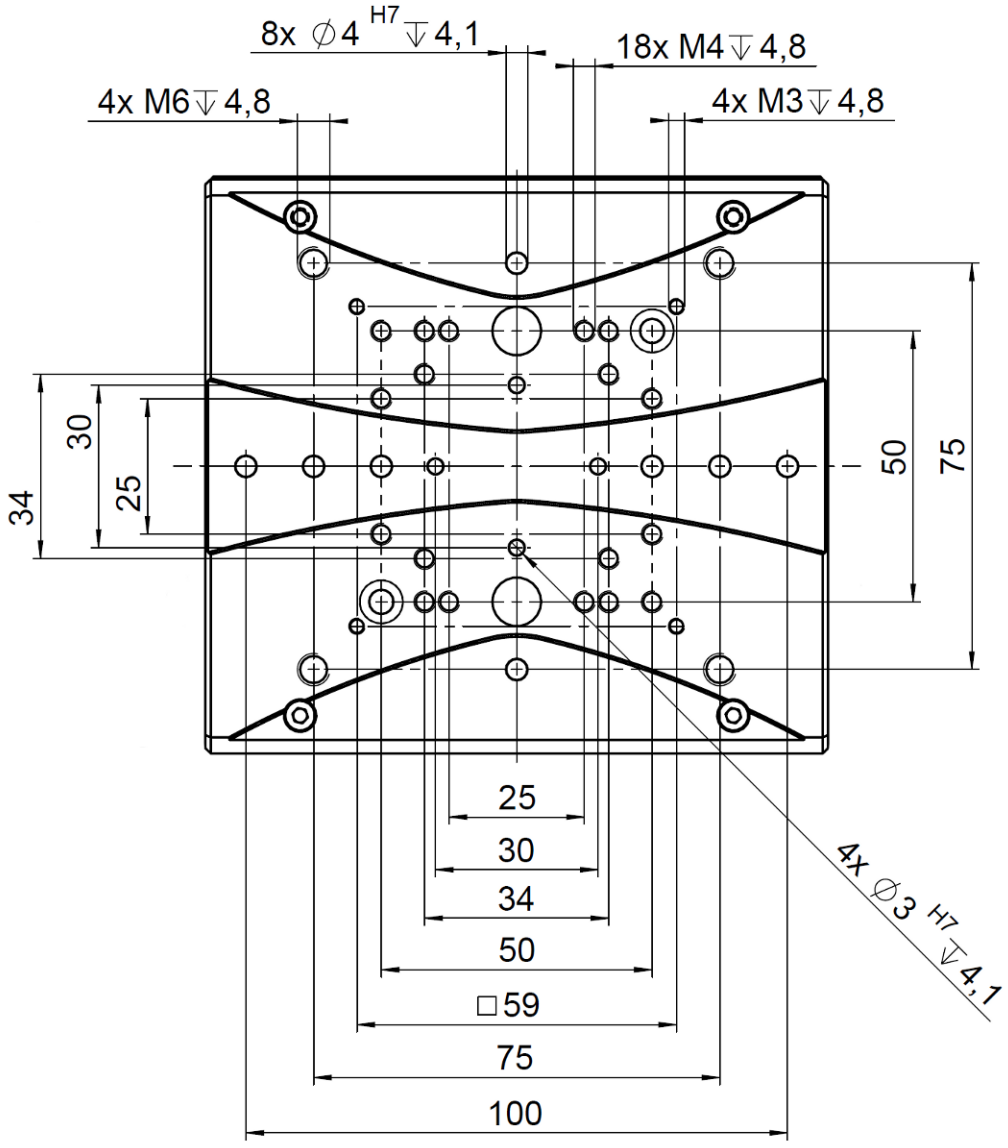


Figure 20: Hole pattern of the moving platform of the M-406 series

10.2.3 M-592.00 Adapter Bracket

Dimensions in mm. Note that the decimal places are separated by a comma in the drawings.

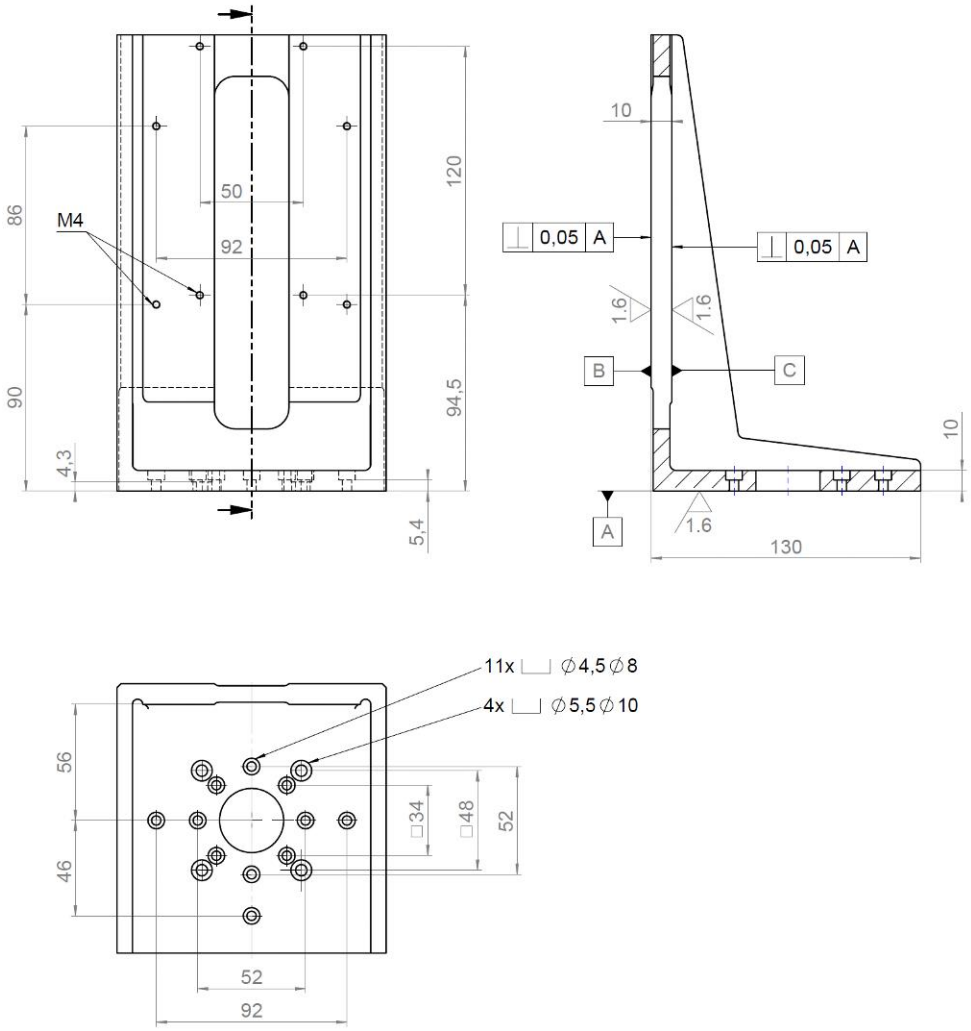


Figure 21: M-592.00 adapter bracket

10.3 Pin Assignment

10.3.1 Sub-D 15 (m) Controller Connection

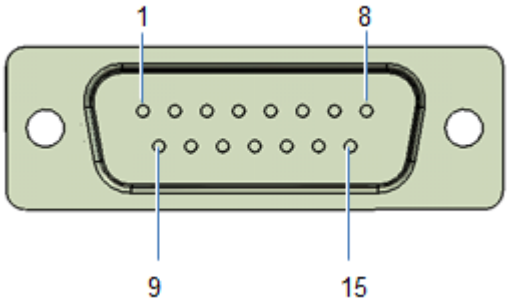


Figure 22: Sub-D 15 (m) controller connection, front view

Models with DC motor

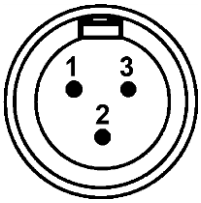
Pin	Signal	Direction
1	Internal	Input
9	M-406.xDG: Motor (-) M-406.xPD: Internal; must not be connected	Input
2	M-406.xDG: Motor (+) M-406.xPD: Internal; must not be connected	Input
10	GND	GND
3	M-406.xDG: Internal; must not be connected M-406.xPG: MAGN (PWM magnitude)	Input
11	M-406.xDG: Internal; must not be connected M-406.xPD: SIGN (PWM sign)	Input
4	+ 5 V	Input
12	Limit_N (negative limit switch)	Output
5	Limit_P (positive limit switch)	Output
13	Reference	Output
6	ID chip (for future use)	Bidirectional
14	Encoder A (+)	Output
7	Encoder A (-)	Output
15	Encoder B (+)	Output
8	Encoder B (-)	Output

Models with stepper motor

Pin	Signal	Direction
1	Motor phase 1A	Input
9	Motor phase 1B	Input
2	Motor phase 2A	Input
10	Motor phase 2B	Input
3	not connected	-
11	not connected	-
4	not connected	-
12	not connected	-
5	ID chip (for future use)	Bidirectional
13	Internal	Input
6	+5 V	Input
14	Limit_P (positive limit switch)	Output
7	GND	GND
15	Reference	Output
8	Limit_N (negative limit switch)	Output

10.3.2 Switchcraft 3-Pin Power Supply Connector

Connecting a power supply is only necessary with the M-406.xPD models.



Pin	Signal	Direction
1	GND	GND
2	24 VDC supply voltage	Input
3	Not connected	-

11 Old Equipment Disposal

In accordance with the applicable EU law, electrical and electronic equipment may not be disposed of with unsorted municipal wastes in the member states of the EU.

When disposing of your old equipment, observe the international, national and local rules and regulations.

To meet the manufacturer's product responsibility with regard to this product, Physik Instrumente (PI) GmbH & Co. KG ensures environmentally correct disposal of old PI equipment that was first put into circulation after 13 August 2005, free of charge.

If you have old PI equipment, you can send it postage-free to the following address:

Physik Instrumente (PI) GmbH & Co. KG

Auf der Römerstr. 1

D-76228 Karlsruhe, Germany

12 EC Declaration of Conformity

For the M-406, an EC Declaration of Conformity has been issued in accordance with the following European directives:

2004/108/EC, EMC Directive

2011/65/EU, RoHS Directive

The applied standards certifying the conformity are listed below.

EMC: EN 61326-1:2013

Safety: EN 61010-1:2010

RoHS: EN 50581:2012